Signatures of Catastrophic Planetesimal Disruptions in the β Pictoris Debris Disk

Thomas J.J. Kehoe[1], Stanley F. Dermott[1], Charles M. Telesco[1], Ludmilla Kolokolova[1], Steven J. Novotny[1], and Mark C. Wyatt[2]

(Email: kehoe@astro.ufl.edu)

[1]Department of Astronomy, University of Florida, Gainesville, Florida
[2]U.K. Astronomy Technology Centre, Royal Observatory, Blackford Hill, Edinburgh, United Kingdom

We investigate the potential for the catastrophic collisional disruption of planetesimals in the β Pictoris debris disk to account for some of the structure observed in the disk, such as the marked brightness asymmetry between the NE and SW lobes and the existence of rings of material. We report preliminary results from numerical simulations that reveal the creation of transient structure in the disk following the release of a power-law size distribution of particles due to the breakup of a planetesimal. The effect of radiation pressure on the particles released causes some of them to be ejected from the system, and we consider the potential for these particles to be the source of the collimated stream detected by the Advanced Meteor Orbit Radar. Those particles that remain in bound orbits rapidly generate a spiral of material that gradually fills out to form an asymmetric disk that is oriented such that the periastron of the particles' orbits lies at the point of the planetesimal's breakup. This disk eventually decays inwards under the effect of Poynting-Robertson drag. We consider the effect of a variety of different parameters on the structure generated in these simulations in order to determine those that are best able to account for the detailed structure revealed by recent high-resolution mid-infrared imaging of the central disk (within ~200 AU from the star) of β Pictoris.